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Biodiversity and Distribution of Gastropods at Seagrass Meadow of Balangdatu Waters Tanakeke Island South Sulawesi Indonesia

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Abstract

The research about the biodiversity of gastropod has been conducted in seagrass meadow of Balangdatu waters, Tanakeke Island, South Sulawesi. The research aims to assess the diversity of gastropod species in Balangdatu waters. Sampling was conducted using quadrat transect method systematically. Three replicates of transect were applied for each station. The result indicates there were 34 species of gastropods from 14 genera and 14 families were found. Diversity index from every station varies from 1,661 to 2,899. These values range from low to moderate. The diversity, Evenness, and dominance indices showed that Balangdatu waters still in good condition and sustain habitat for gastropod.

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Keyword

Biodiversity

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Spermonde

Introduction

Gastropods are known as snails that has more diverse members in the phylum of Mollusks. Main characteristics of this group are single shell, well-developed head and its body is completed by tentacle, eyes and radula. Some gastropods are economics important due a valuable shell for ornament materials and souvenirs or meat as protein sources for human. Therefore, gastropods are recognized as potency group that can contribute to coastal community commodity welfare and fishery productivity at coastal areas. Amongst mollusks group, Gastropods is a successful group in term of widely distributed. They can be found in almost all habitats including the terrestrial, freshwater, and deep sea. Gastropods are also found living in different coastal ecosystem including mangrove, seagrass meadows and coral reefs. (Tomascik *et al.*, 1997).

Coastal communities utilized seagrass meadows for different purposes such as fishing ground, collecting snail as seaweeds aquaculture. On coastal aquaculture practice, this area is often cleaned from unwanted organisms including parasite of seaweed. This action will contribute to damage of seagrass meadows. Hence, seagrass ecosystems are a threat worldwide. Many studies have been conducted on Mollusca around Indonesia, but still less studied on seagrass meadows of South Sulawesi (Litaay 2006, Kusanadi 2008, Litaay *et al.*,

2010, Arbi 2011, Metungun *et al.*, 2011). On of coastal area in South Sulawesi province that has seagrass meadows that used for seaweed cultivation is Tanakeke Island of Takalar Regency. High activity of human along Tanakeke coastal area to some extent will contribute to a change in water quality that will disturb seagrass meadow. Information on associate biota to seagrass meadows from this area is limited. Information on biodiversity of associate biotas to different ecosystems is needed to support sustainable used of coastal and marine resources. The aim of the present study on gastropods diversity that associates with seagrass meadows of Balangdatu water of Tanakeke Island South Sulawesi is needed to support sustainable use these resources.

Materials and Methods

Sampling Site

Sampling site was determined based on water condition, topography, habitat type, distribution of seagrass meadows and community activity along the coast of Balangdatu. We divided sampling sites into three areas as follows:

Site 1 : close to lagoon, substrate rubble, seaweed cultivation area,

Site II : seaweed cultivation areas, substrate sand,

Site III : close to human settlement, substrate muddy sand, many seaweeds cultivation

Sampling Methods

Sampling method of transect combination with the plot was used systematically during gastropods collection (Modified English *et al.*, 1997, Hemminga and Duarte 2000, Priosambodo 2014). Three transects and two replicates were applied at each sampling site. Each transect was divided into 5 plot. A transect was placed at seagrass offshore until reach top end that seagrass was found. Balangdatu has 4,800 m coastal line in which seagrass meadows areas, divided into three sites: Sta. I: 150 m², Sta. 2: 300 m² and Sta. 3: 600 m². Gastropods in all transect were collected, cleaned and preserved into 70% alcohol, brought to the laboratory for further identification. Samples were photographed in situ before being preserved. Identification was done based on main characters (Dharma, 2005).

Environment Parameters

Environment parameters including salinity, temperature, pH, dissolved oxygen and sediment type were measured in situ, respectively.

Data Analysis

Ecology indices included absolute density, species diversity, evenness, dominance index, and dispersal pattern was applied in this study. Data was analysed according to formulas as follows (Odum 1993):

a. Density (D_i) = n_i/A , where:

A = Density species i ;

n_i = Total No of ind species i ;

L = Total area of plot

b. Simpson Dominance Index $C = \sum (n_i / N)^2$, where :

n_i = No of ind species – i

N = Total no of ind all species

Criteria :

- 0 < C ≤ 0,5 = Low
 0,5 < C ≤ 0,75 = Moderate
 0,75 < C ≤ 1,00 = High

c. Shanon-Wiener Diversity Index $H = -\sum (n_i / N) \ln (n_i / N)$, where :

- n_i = Number of species - i
 N = Total number of species
 H' = Diversity Index

Criteria :

- 0 < H' ≤ 2,0 = Low
 2 < H' ≤ 3,0 = Moderate
 3,0 < H' ≤ 4,0 = High

d. Morisita Index $I_d = n \frac{\sum X^2 - N}{N(N-1)}$, where :

- n = No of plot/transect = $\sum F(x)$
 N = Total no of indiv inside plot/transect = $\sum [F(X)] (X)$
 $\sum X^2$ = quadrate no of indiv inside plot = $\sum [F(X)] (X^2)$

Criteria :

- $I_d < 1,0$ = Randomly distributed
 $I_d = 1,0$ = Uniformly distributed
 $I_d > 1,0$ = Clumped distributed

Results and discussion

Species Composition

We found 14 families and 14 genera of Gastropods that consists of 34 species. These species are *Aluco aluco*, *Chicoreus capucinus*, *Conus eximus*, *Conus ferrugineus*, *Conus magus*, *Conus varius*, *Cymbiola vesvertillo*, *Cypraea annulus*, *Cypraea talpa*, *Cypraea tigris*, *Cypraea vitellus*, *Engina alveolata*, *Engina armilata*, *Engina concinna*, *Lambis lambis*, *Lambis truncata*, *Littoraria scabra*, *Nassarius arcularius*, *Nassarius jacksonianus*, *Nassarius olivaceus*, *Nassarius reeveanus*, *Nassarius stolatus*, *Nassarius venustus*, *Nerita squamulata*, *Oliva tigris*, *Oliva taeniata*, *Polinices mammilla*, *Polinices melanostomus*, *Pyrene decussata*, *Rhinoclavis vertagus*, *Strombus labiatus*, *Strombus urceus*, *Thais tuberosa*, *Trochus californicus*.

Amongst 34 species of gastropods, 7 species was found at St. I, 24 species was at Sta. II, and 13 species at Sta. III. In terms of species composition, Gastropoda from family Nassariidae genus Nassarium are more abundance with 6 species. On the other hand, family Ciiridae, Columbellidae, Littorinidae, Neritopsidae, and Volutidae only consist of 1 species. This study found *Strombus urceus* occurred frequently, counted for 41.379% from total occurrence.

Density

The result shows that absolute density of gastropods at each station are follows: Sta. I 0.06-0.8 ind/m², Sta. II 0.06-0.5 ind/m², and Sta. III 0.06-2.22 ind/m² (Table 1). *Strombus urceus* shows highest occurrence at Sta. I (41.379%) (Table 2). This in accordance with study done by Arbi (2001). He found that *Strombus urceus* was one of gastropods that distributed widely at Talise waters of North Sulawesi. The lowest density was shown by *Chicoreus capucinus* and *Thais tuberosa*. Seagrass meadows of Balangdatu waters were situated nearby mangrove and coral reefs may allow some gastropods that origin from coral reef areas as hard substrate were found at seagrass areas. The last two species *Chicoreus capucinus* and *Thais tuberosa* that present at seagrass meadows may due to tidal at that location. Supriharyono (2000) argued that current have contributed significantly to a dispersal or movement from benthic fauna from one ecosystem to others.

Table 1. Occurrences of gastropods at three sampling sites

No	Species	Sta. 1	Sta. 2	Sta. 3
1	<i>Aluco aluco</i>	-	+	+
2	<i>Chicoreus capucinus</i>	-	+	-
3	<i>Conus eximus</i>	-	+	-
4	<i>Conus ferrugineus</i>	+	+	+
5	<i>Conus magus</i>	-	+	-
6	<i>Conus varius</i>	-	+	-
7	<i>Cymbiola vesvertillo</i>	+	-	+
8	<i>Cypreae annulus</i>	-	+	-
9	<i>Cypreae talpa</i>	-	+	-
10	<i>Cypreae tigris</i>	-	-	+
11	<i>Cypreae vitellus</i>	+	+	+
12	<i>Engina alveolata</i>	-	+	-
13	<i>Engina armilata</i>	-	-	+
14	<i>Engina concinna</i>	-	+	-
15	<i>Lambis lambis</i>	+	-	+
16	<i>Lambis struncata</i>	-	+	-
17	<i>Littoraria scabra</i>	-	+	-
18	<i>Nassarius arcularius</i>	-	+	-
19	<i>Nassarius jacksonianus</i>	-	+	-
20	<i>Nassarius olivaceus</i>	-	+	-
21	<i>Nassarius reeveanus</i>	-	+	-
22	<i>Nassarius stolatus</i>	+	-	-
23	<i>Nassarius venustus</i>	-	+	-
24	<i>Nerita squamulata</i>	-	+	-
25	<i>Oliva tigris</i>	-	+	+
26	<i>Olivia taeniata</i>	-	+	-
27	<i>Polinices mammilla</i>	-	+	-
28	<i>Polinices melanostomus</i>	-	-	+
29	<i>Pyrene decussata</i>	-	+	-
30	<i>Rhinoclavis vertagus</i>	-	-	+
31	<i>Strombus labiatus</i>	+	-	-
32	<i>Strombus urceus</i>	+	+	+

33	<i>Thais tuberosa</i>	-	-	+
34	<i>Trochus sp</i>	-	-	+

Table 2. Density of Gastropods at seagrass meadows of Balangdatu waters Tanakeke

No.	Gastropods	Density (ind/m ²)		
		Sta. I	Sta. II	Sta. III
1	<i>Aluco aluco</i>	0	0.200	0.533
2	<i>Chicoreus capucinus</i>	0	0.066	0
3	<i>Conus eximus</i>	0	0.266	0
4	<i>Conus ferrugineus</i>	0.200	0.133	0.933
5	<i>Conus magus</i>	0	0.200	0
6	<i>Conus varius</i>	0	0.066	0
7	<i>Cymbiola vesvertillo</i>	0.133	0	0.533
8	<i>Cypraea annulus</i>	0	0.666	0
9	<i>Cypraea talpa</i>	0	0.067	0
10	<i>Cypraea tigris</i>	0	0	0.400
11	<i>Cypraea vitellus</i>	0.333	0.133	0.133
12	<i>Engina alveolata</i>	0	0.466	0
13	<i>Engina armilata</i>	0	0	0.200
14	<i>Engina concinna</i>	0	0.333	0
15	<i>Lambis lambis</i>	0.133	0.000	0.066
16	<i>Lambis struncata</i>	0	0.066	0
17	<i>Littoraria scabra</i>	0	0.066	0
18	<i>Nassarius arcularius</i>	0	0.200	0
19	<i>Nassarius jacksonianus</i>	0	0.133	0
20	<i>Nassarius olivaceus</i>	0	0.200	0
21	<i>Nassarius reeveanus</i>	0	0.066	0
22	<i>Nassarius stolatus</i>	0.267	0	0
23	<i>Nassarius venustus</i>	0	0.066	0
24	<i>Nerita squamulata</i>	0	0.800	0
25	<i>Oliva tigris</i>	0	0.533	0.133
26	<i>Olivia taeniata</i>	0	0.266	0
27	<i>Polinices mammilla</i>	0	0.400	0
28	<i>Polinices melanostomus</i>	0	0	0.466
29	<i>Pyrene decussata</i>	0	0.266	0
30	<i>Rhinoclavis vertagus</i>	0	0	0.133
31	<i>Strombus labiatus</i>	0.067	0	0
32	<i>Strombus urceus</i>	0.800	0.400	2.200
33	<i>Thais tuberosa</i>	0	0	0.066
34	<i>Trochus sp</i>	0	0	0.066
Total		1.933	6.058	5.862

Species Diversity (H')

Diversity index ranged from 1,661 to 2,899 (Table 3). According to Brower *et al.*, (1990) these values are categorized as low to moderate. Low diversity in Sta. I may due to habitat which dominated by rubble. Comparing to substrates at Sta. II and Sta. III, less nutrient available in this Sta. I type of substrate may contribute to species diversity.

Table 3. Species Diversity Index (H') and Evenness Index (E)

No.	Sta.	Species Diversity Index (H')		Evenness Index (E)	
		Value	Category	Value	Category
1	I	1.661	Low	0.853	Stable
2	II	2.899	Moderate	0.912	Stable
3	III	2.006	Moderate	0.782	Stable

Evenness Index (E)

This study revealed that sampling site shows stable condition as shown by values of Evenness 0,782 – 0,912 (Table 3). Stable community allows species to occupy equally or they show distribution pattern of more or less equal. Environmental condition that relatively same would allow species to widely distributed at Balangdatu waters. Different type of habitats would have influence species distribution in nature. Leaf density of seagrass as habitat is also affected macrozoobenthos including gastropods as reported by Hemminga and Duarte (2000).

Dominance Index (C)

In the present study, value of dominance Index ranges from 0.0001 to 0.140 (Table 4). This reveals that community in stable condition as dominance index close to zero, as indication that there is no dominant species. Also, competition amongst species may also result in space distribution Odum (1993).

Table 4. Dominance Index (C) and Morisita Index at different sampling sites

No.	Gastropods	Indices					
		Dominance (C)			Morisita (Id)		
		Sta. I	Sta. II	Sta. III	Sta. I	Sta. II	Sta. III
1	<i>Aluco aluco</i>	0	0.001	0.008	-	1	0.33
2	<i>Chicoreus capucinus</i>	0	0.0001	0	-	~	-
3	<i>Conus eximus</i>	0	0.001	0	-	1	-
4	<i>Conus ferrugineus</i>	0.01	0.00048	0.025	1	1	0.259
5	<i>Conus magus</i>	0	0.001	0	-	1	-
6	<i>Conus varius</i>	0	0.0001	0	-	~	-
7	<i>Cymbiola vesvertillo</i>	0.004	0	0.008	1	-	0.485
8	<i>Cypaea annulus</i>	0	0.012	0	-	0.684	-
9	<i>Cypraea talpa</i>	0	0.0001	0	-	~	-
10	<i>Cypraea tigris</i>	0	0	0.004	-	-	0.413
11	<i>Cypraea vitellus</i>	0.029	0.0004	0.0005	0.59	1	-0.06
12	<i>Engina alveolata</i>	0	0.005	0	-	1	-
13	<i>Engina armilata</i>	0	0	0.001	-	-	0.119
14	<i>Engina concinna</i>	0	0.003	0	-	0.727	-
15	<i>Lambis lambis</i>	0.004	0	0.0001	1	-	~
16	<i>Lambis struncata</i>	0	0.0001	0	-	~	-
17	<i>Littoraria scabra</i>	0	0.0001	0	-	~	-
18	<i>Nassarius arcularius</i>	0	0.0001	0	-	1	-
19	<i>Nassarius jacksonianus</i>	0	0.0004	0	-	1	-

20	<i>Nassarius olivaceus</i>	0	0.001	0	-	1	-
21	<i>Nassarius reeveanus</i>	0	0.0001	0	-	~	-
22	<i>Nassarius stolatus</i>	0.019	0	0	1	-	-
23	<i>Nassarius venustus</i>	0	0.0001	0	-	~	-
24	<i>Nerita squamulata</i>	0	0.017	0	-	0.762	-
25	<i>Oliva tigris</i>	0	0.007	0.0005	-	1	-0.06
26	<i>Olivia taeniata</i>	0	0.001	0	-	0.624	-
27	<i>Polinices mammilla</i>	0	0.004	0.006	-	0.611	-
28	<i>Polinices melanostomus</i>	0	0	0	-	-	0.523
29	<i>Pyrene decussata</i>	0	0.001	0	-	0.624	-
30	<i>Rhinoclavis vertagus</i>	0	0	0.0005	-	-	0,060
31	<i>Strombus labiatus</i>	0.001	0	0	~	-	-
32	<i>Strombus urceus</i>	0.171	0.004	0.14	0.89	0.525	0.517
33	<i>Thais tuberosa</i>	0	0	0.0001	-	-	~
34	<i>Trochus sp</i>	0	0	0.0001	-	-	~

Distribution Pattern (Id)

Generally, gastropods at almost sampling sites shows clumped distribution, although some species were widely distributed. Clumped distribution is shown by value of Morisita Index is close to zero, as described in Table 4. Odum (1993) explained that distribution pattern of species are correlated to feeding habit or feeding mode. Species tends to form a group where more food are available. Beside, external reproduction as characteristics of substrates may also contribute to certain distribution pattern of species such as clumped distribution. Gastropods such as *Cypraea vitellus*, *Engina armilata*, and *Oliva tigris* show equal distribution, this pattern indicating that there is competition amongst species, hence space distribution equally.

Environment Parameters

Environment parameters are shown in Table 5. As seen from Table 5, water temperature ranged from 31.77 to 34.17°C. These temperatures are in favor to molluscs especially gastropods. Gastropods are having a thick shell, allows this group to survive at quite high temperature. Marine fauna can live normally in water with temperature of 26 - 32°C, although several invertebrate fauna can adopt to a high temperature Odum (1993). The present study indicates that salinity of Balangdatu water of about 33.67 ‰ – 34.67 ‰, respectively (Table 5), in which is suitable for macrozoobenthos. Metungun *et al.*, (2011) stated that salinity of 25 – 40‰ is good for marine gastropods. pH value of sampling site varied from 6.92 to 7.19 (Table 5), these pH ranged can be tolerated by marine organisms, even though pH marine water can be varied between 7.5 and 8.4. Gross (1972) in Metungun *et al.*, (2011), most of the aquatic gastropods can live at pH of 5-9. In terms of dissolved Oxygen (DO), Balangdatu waters contain 4.5 to 5.17 mg/L (Table 5). Another study at Bone Batang gusung at seagrass meadows showed a similar pattern where DO ranged from 4.6 to 5.5 mg/L. These values support optimal growth for seagrass.

Furthermore, the result of sediment analysis indicates that substrates at sampling sites were categorized as sandy clay (Table 5). Sediment texture differ amongst sampling sites as follows sand (65.00 % - 67.33 %), dust (11.04-15 %) and clay (4.40-5.30 %). The texture of sediment at seagrass meadows of Balangdatu differs from the common structure at

Spermonde archipelago that dominated by sand, rubble and gravel (Sawall *et al.*, 2011; 2013), Progeroutz *et al.*, 2012).

Table 5. Environment Parameters at seagrass meadows of Balangdatu waters

Parameters	Sampling site		
	Sta. I	Sta. II	Sta. III
Temperature (°C)	31.77	33.1	34.17
pH	7.19	6.92	7.19
Salinity (‰)	33.67	34.67	34.67
DO (mg/l)	4.5	5.13	4.97
Substrates	Sandy clay	Sandy clay	Sandy clay

Conclusions

The present study concludes, based on ecology indices, Balangdatu waters of Tanakeke Takalar South Sulawesi is still in good condition and support marine gastropods.

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